Analysis on Overhead Circular water tank for various bearing capacity with sloping ground.

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Abstract- Large capacity elevated circular tanks are used to store a variety of liquids, e.g. water for drinking and fire fighting, petroleum, chemicals, and liquefied natural gas. A water tank is used to store to tide over the daily requirements. Intze tank is a type of elevated water tank supported on staging circular tanks is defined as bottom portion of circular tank is provided in flat shape, so in flat bottom, the thickness and reinforcement is found to be heavy. It is found in analysis that the bearing capacity increases for the same wind speed volume of concrete and quantity of steel both are decreased. Also, We have seen that in case of bearing capacity of soil 5 t/m2 and 10 t/m2 volume of concrete and quantity of steel are so high as compared to other.

Comparison of different forces induced in various members of tank on leveled surface & with increasing slope for different heights has been thoroughly studied. Axial force, shear force & bending moment are compared for different structural components of tank viz. base beams, columns & bracings. The present study aims at evaluating the effect of sloping ground on column and braces at different bracing level. The optimized column section for different slopes is evaluated.

Key words:, Circular tank, Over Head Tank, Soil Parameter, Wind Effect . Bending Moment, Continuity Analysis, Elevated Storage Reservoir, Shear Force, Sloping Ground.

I. INTRODUCTION

Storage of water in the form of tanks for drinking and washing purposes, swimming pools for exercise and enjoyment and sewage sedimentation tanks are gaining increasing importance in the present day life. A water tank is used to store water to tide over the daily requirements. The hilly seismic regions of our country ranges from Jammu and Kashmir, Himachal Pradesh, Manipur, Tripura, Mizoram. The Western Ghats better known as Sahyadri are a hilly range running parallel to the coast. Kalsubai, a peak in the Sahyadris is the highest elevated point in Maharashtra. Due to rapid urbanization and economic development, it is important to make the optimistic combinations of structure on sloping ground.

II OBJECTIVES

1 To study the effects of bearing capacity of soil on the quantity of concrete and steel required to construct circular tank.
2Variation of axial force, shear force and bending moment will be compared for different components of tank like columns, base beam and bracing beam due to sloping ground.

III. THEOROTICAL FORMULATION

In this paper, water tank is analyzed by continuity analysis method because it is assumed that joints are monolithic therefore one need to construct the various components of water tank simultaneously for ensuring monolithicness. Merlecha analyzed the water tank on sloping ground using continuity analysis for four columns configuration, the author found that the increase in flexural action in most of the cases is maximum when the level difference between the columns is about mid height of bottom bay column. The present work employs continuity analysis for studying nine columns ESR having a storage capacity of 2 lac liters for 9m and 12m staging heights on sloping ground.

Merlecha S.K. (2002) studied on "Analysis of Water tank on Sloping ground". The author analyzed water tanks on level as well as on sloping ground. Four column staging is used for two heights of staging one of which is 9m high and another is 12m high. Six models for each staging height are studied for different level difference. For 9m height staging interval is kept 3m and for 12m height staging interval is kept 4m. Earthquake forces are calculated for each model as per I.S 1893-1984 and the models are analyzed. Variation in forces for different components of tank like base beam, column and bracing beam is studied for all 12 models.

.METERIAL AND METHODOLOGY

Design Of Elevated Water Tanks .This study has emphases merely on elevated tank. Design of liquid retaining structure has to be based on the avoidance of cracking in the concrete having regard to its tensile strength. It has to be ensured that no cracks in

the concrete should be formed on the water face. The design of such tank in is done in two stages:-

(i) Membrane analysis

(ii) Analysis taking into account continuity effect at joints.

(iii) Membrane analysis: - In membrane analysis, the members are assumed to act independent of the others. The members are therefore subjected to only direct stresses and no bending moment is introduced.

(i) Analysis taking into account continuity effect at joints: - In membrane analysis, it was assumed that each members is independent of the other and therefore subjected to direct stresses only. However, due to continuity of joints between the members, joint reactions are introduced, due to which secondary stresses in the form of edge moment and hoop stresses are induced in members. Stresses due to continuity can be obtained by applying the principle of consistent deformations. At each joint, the horizontal deformation and angular displacement between the shells should be consistent.

PERMISSIBLE STRESS IN CONCRETE

a) For resistance to cracking: The permissible tensile stresses due to bending apply to the face of the member in contact with liquid. The member with thickness less than 225 mm and contact with the liquid on one side, these permissible stresses in bending apply also to the face remote from the liquid.

b) For strength calculation: In strength calculation the usual permissible stress, in accordance with IS: 456-2000, is used. Where the calculated shear stresses in concrete above exceed the permissible value, reinforcement acting in conjunction with diagonal compression in concrete shall be provided to take the whole of the shear.

PERMISSIBLE STRESS IN STEEL

a) For resistance to cracking: When steel and concrete are assumed to act together for checking the tensile stress in concrete for avoidance of cracking the tensile stress in steel will be limited by the requirement that the permissible tensile stress in concrete is not exceeded so that tensile stress in steel shall be equal to the product of modular ratio of steel and concrete and the corresponding allowable tensile stress in concrete. b) For strength calculation: In strength calculation the permissible stress in steel, in accordance IS: 3370 are used. When water is filled in tank container, the hydrostatic pressure will try to increase the diameter at any section of the tank. However, this increase in the diameter in all along the height of the tank will depend upon the nature of the joints. If the joint is flexible, it will be free to move outward and when the joint is fixed, no movement is possible, then a fixing moment will be induc

III. PARAMETRIC STUDY

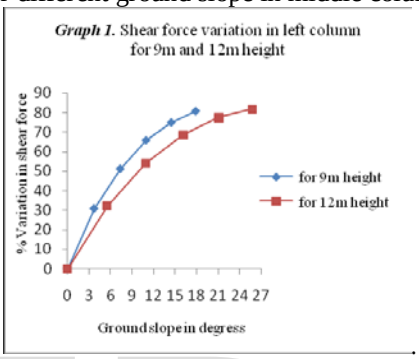
In present parametric work, comparison of axial force, shear force and bending moment for various ground slopes are carried out for 9m and 12m staging heights of water tanks. The percentage variation in shear force and bending moment for different ground slopes are shown with the help of graphs. Also, the required cross-sectional area of column section with respect to different slopes is shown with the help of graphs.

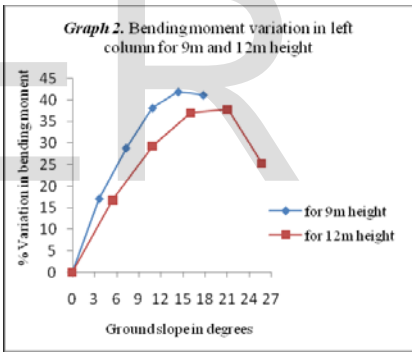
A. Variation of shear force and bending moment for 9m and 12m height of tank Graph 1: shows percentage variation in shear force for different ground slope in left column (which is on higher side). It is observed that as the ground slope increases percentage variation in shear force for both the staging heights also increases. However, the rate of increase in shear force becomes milder with increasing slope. Also, as the staging height increases the rate of increase of shear force becomes milder.

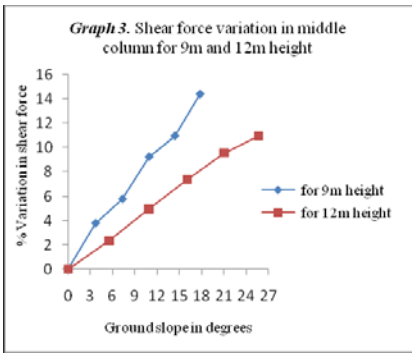
Graph 2: shows percentage variation in bending moment for different ground slope in left column (which is on higher side).It is observed that as the ground slope increases percentage variation in bending moment also increases up to 14°for 9m height and up to 21°for 12m height respectively, thereafter, it decreases in both the cases. However, the rate of increase in bending moment becomes milder with increasing slope. With increasing staging height the percentage variation in bending moment decreases

Graph 3. shows percentage variation in shear force for different ground slope in middle column.

Graph 4. shows percentage variation in bending moment for different ground slope in middle column.







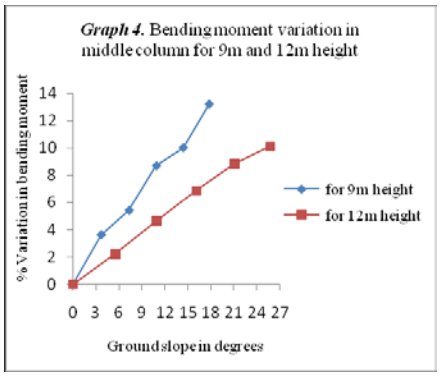
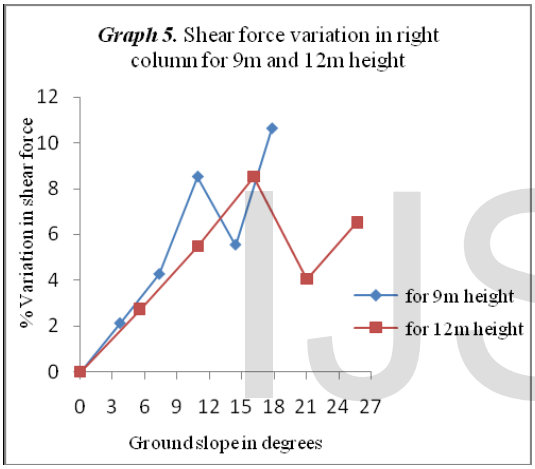
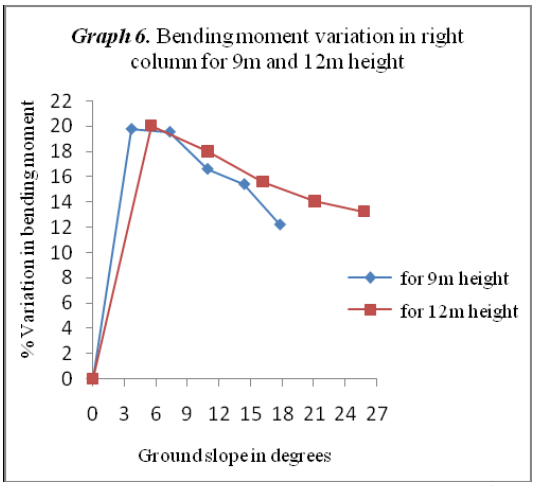


Diagram (S.F.D)shows Bending Moment Diagram (B.M.D) for ESR having staging height of 9m and 12m respectively on level and sloping ground.

Effect on shear force It is observed that shear force increases in the part of a column resting on the higher side of the sloping ground as shown in Fig.2. On the sloping ground the shear force is maximum which is more than 5 times that of shear force for a frame on level ground. As we go to upper storey, the shear force decreases drastically at first floor level, there afterwards for upper floors it is nearly same compared to first floor level as shown in Fig.2.

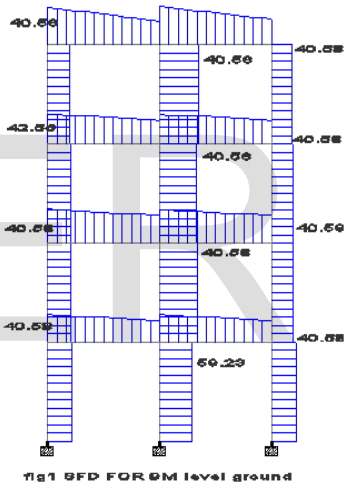
Effect on bending moment The bending moment at the ground bracing level on the higher side of the sloping ground is nearly double in comparison with frames on level ground as shown in Fig.3. As one moves towards middle and the right hand side column it is observed that the nature of bending moment from footing to ground brace level changes

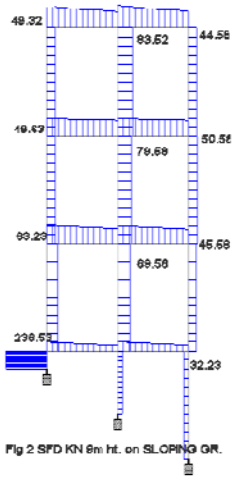


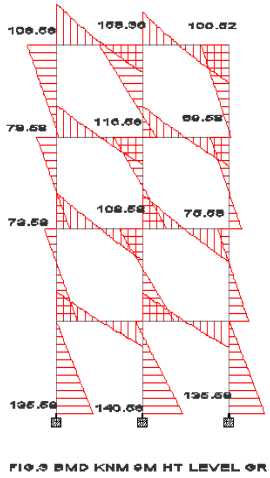


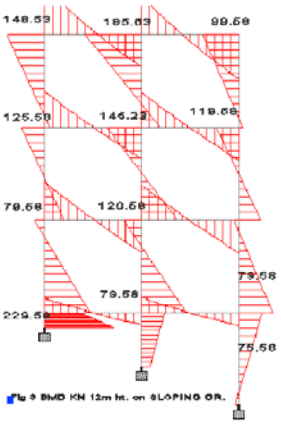
Graph 5.. . shows percentage variation in shear force for different ground slope in right column.

Graph 6 shows percentage variation in bending moment for different ground slope in right column.

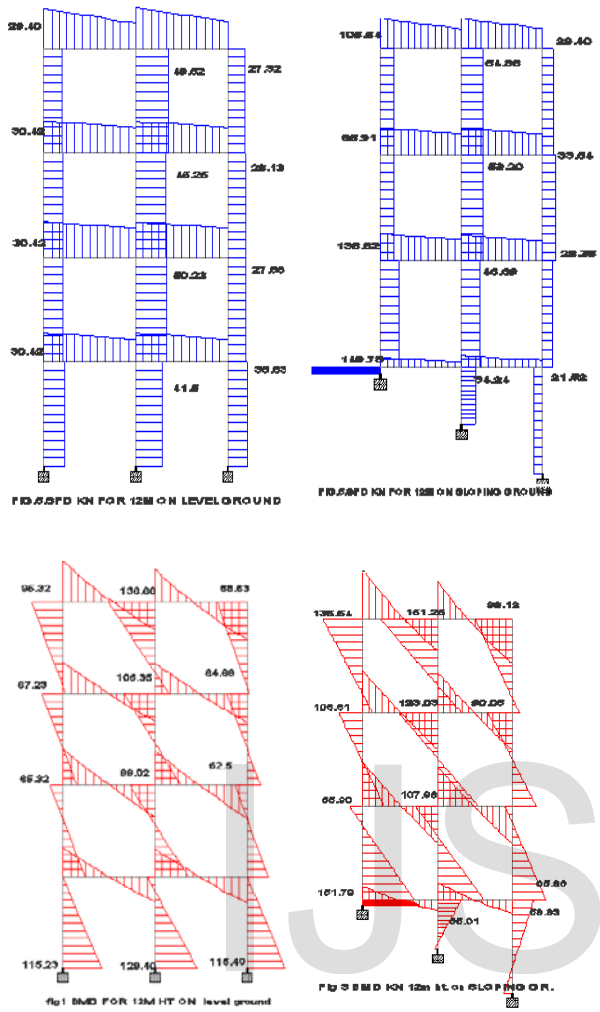








C. Schematic sketch of shear force and bending moment diagram for 9m and 12m height of tank The Fig.1, Fig.2, shows Shear Force



Effect of Wind speed The summary of design of circular tank for the various wind speed and various soil parameter is given in graph below. 1. Results of circular tank: bearing capacity 30 t/m2:- In this result for 30 t/m2 bearing capacity of soil and different wind speed Volume of concrete (Vsc) and Volume of steel (Vst) are given below for super structure and sub structure.

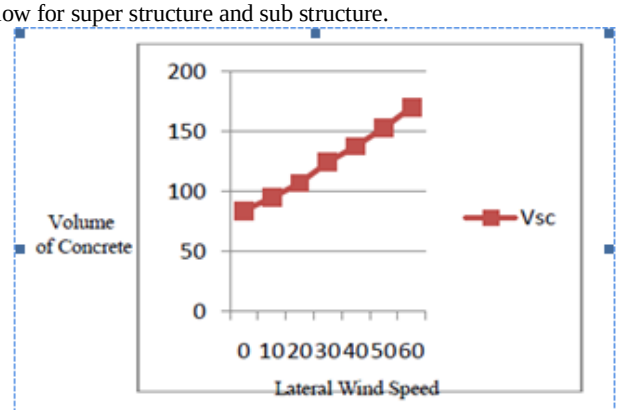


Fig 1.1 Between wind speed and vol of conceret

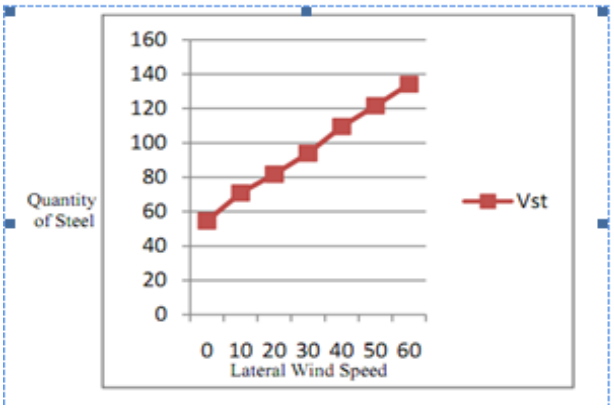


Fig 1.2 Between wind speed and vol of steel

2(bearing capacity 25 t/m2):- this result for 25 t/m2 bearing capacity of soil and different wind speed Volume of concrete (Vsc) and Volume of steel (Vst) are given below for super structure and sub structure.

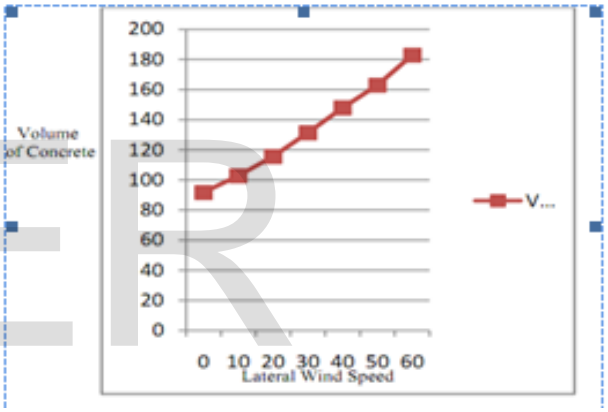


Fig 2.1 Between wind speed and vol of concerete

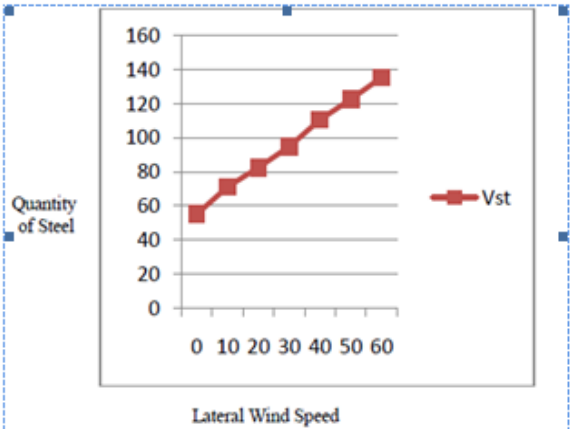


Fig 2.2 Between wind speed and qty of steel

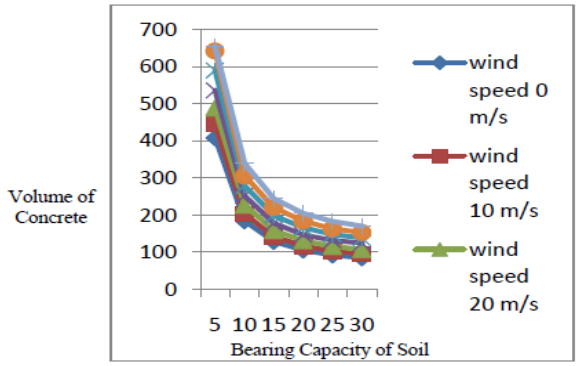


Fig 2.3 Combined graph of bearing capacity of soil, volume of concrete and wind speed

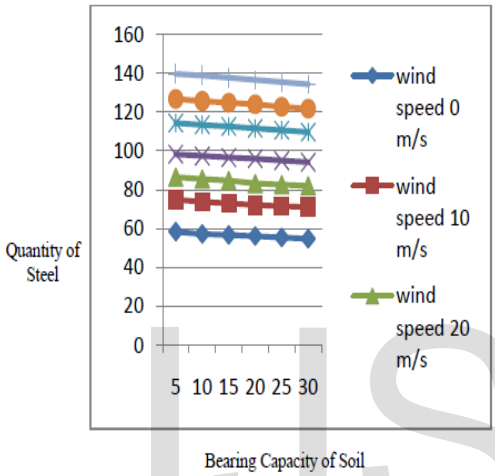


Fig 2.4 Combined graph of bearing capacity of soil, quantity of steel and wind speed.

CONCLUSION

We have seen that the result of Circular tank for the different wind speed and different bearing capacity in the form of graphs. From the above result as discussed as below:-

1 For the ESR on sloping ground, it is observed that both shear force and bending moment increases steeply in the column resting on the higher side of the sloping ground.

2 Increase in Shear force & Bending Moment becomes milder as one goes towards downward side of slope.

3. It is also observed that as one moves towards upper stories, effect of increse in shear force & bending moment due to sloping ground becomes still milder.

4 There is no significant change in axial force with respect to variation of slope of ground. For the increase in height of staging, the cross section of required area of column also increases.

5. As the wind speed increases for the same bearing capacity volume of concrete and quantity of steel both are increased.

6. As the bearing capacity increases for the same wind speed volume of concrete and quantity of steel both are decreased

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